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A STUDY OF THE LEGIBILITY OF DESTINATION SIGN ARROWS

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IN an attempt to prove the effectiveness of destination signs on the state highways, several questions arise as to arrow design. Is a skeleton or a solid head arrow more easily seen? Is a 30° head or a wider angle better? Is a short shaft as effective as a long shaft, or does the space saved on the sign represent false economy? How far is it of value to increase the width of the shaft and of the whole arrow itself? How far can an unreflectorized wood arrow cut to form a point be seen at night or be seen in the daytime against a snow background? What would be the feasibility of increasing the present four inch letter to larger copy without increasing the 9 x 52 inch size of the present wooden sign unit in use in Connecticut? Such were the questions presented.

Since a previous study elsewhere[1] had answered certain of the questions with regard to the legibility of letters of the standard square design recommended by the Uniform Manual of Traffic Control Devices, the next logical step was a study of the effectiveness of different arrow designs. Accordingly, a joint study was undertaken by the Yale Bureau and the Connecticut Highway Department using a method similar to that reported by one of the authors[2] and used in the previous study. In order to use a smaller group of observers, and thus to short cut the time and effort needed, two series of observations were obtained on the same alphabet used with the large number of observers in the previous study. Thus it was possible to tie in the present observations and to place the smaller sample obtained in its proper position relative to a larger group of observers.

A series of wood test signs was made up using the standard black on white color scheme. A total of fifty-nine different arrow designs were devised, and a total of about forty-six hundred observations were made on the arrows alone by thirty-nine different observers. Nineteen of the observers were students at the Bureau for Street Traffic Research, and twenty were from the Highway Department.

In testing the efficiency of signs by means of the performance of a group of observers, it is always necessary to control the possibility of guessing by the observer. This guessing may be quite unintentional, and therefore it is not sufficient to obtain observers whose integrity and cooperation are unquestioned. Accordingly, two control signs were used in each presentation of twenty-four arrows, and the

* We are indebted for the interest of Highway Commissioner William J. Cox, Mr. W. Howard Sharp, Head of the Connecticut Highway Department, Traffic Division, and of Mr. Maxwell Halsey, Associate Director of the Bureau for Street Traffic Research.

1. Forbes, T. W. and Holmes, R. S. Legibility distances of highway destination signs in relation to letter height, letter width and reflectorization. Proc. Hway. Res. Bd. 1939, 19, 321-335. (Joint Study-Yale Bureau and Pennsylvania Turnpike Commission).

2. Forbes, T. W. A method for analysis of the effectiveness of highway signs. Jour. Applied Psychol. 1939, 23, 669-684.

arrows were placed unpredictably in any of four positions. As in the previous study, the observers were sent to a distant position, the twenty-four test arrows were then set up on posts beside the highway, the observers walked toward the signs until they could read the most legible one, and recorded the distance marked on the highway at that spot. Distances were marked in twenty foot intervals. After all the observers had approached sufficiently close to have read and recorded all of the legibility distances, they again returned to the starting point and repeated the process to give a second reading on the same set of signs. In the meantime, the twenty-four test signs had been changed in position and direction, so that the second set of observations would not be affected by the first one.

For night observations the same process was followed, except that the observers were riding in or on or grouped closely around a car whose headlights furnished the necessary illumination for the sign. Previous work has shown that this method gives approximately the same results as observations taken by a group of observers all of whom are riding in cars, and it has the advantage of consuming far less time.

The test arrows were designed to answer the question "Given a certain amount of available space, what combination of arrow characteristics gives the greatest legibility distance?" The designs were derived by varying systematically four different parameters, i.e., the angle of the head, the amount to which the head was filled in, the length of the stroke, the width of the stroke, and the over-all height of the arrow (point to point width). In addition to painted black arrows on white backgrounds, three other types of arrow in common use were used, i.e., a white board cut to form an arrow, a white arrow outlined by black paint on a board now in use in Connecticut, and an arrow formed by a pair of painted 60° lines on the standard white board.

The painted arrows were of four inch, six inch and eight inch point to point width. The six inch series was reflectorized throughout, and certain of the four inch and eight inch were likewise reflectorized for use in the night observations.

Observations were made comparing the legibility distances of rounded and square standard Series D letters, but these will not be treated in this report.

The observations were obtained in two afternoons and two evenings, or a total of from ten to twelve hours' work, thus indicating the practical nature of the method. The analysis of the results will be reported in detail later. It is at present incomplete, but certain general results can be indicated at the present time tentatively.

In the first place, it was discovered that in making such observations there are three distances to be considered. These distances are: a. The farthest point at which direction can be recognized if the sign is known to be an arrow. b. A middle point at which the observer can recognize the shape of an arrow and its direction, but cannot tell its design. c. A nearer point at which both the direction and the detail of the arrow design can be recognized. Since at Point "a" the observer cannot differentiate an arrow from other designs unless he knows it to be an arrow due to previous information from the test set-up, this point obviously does not give a distance comparable to what the average driver will be able to see on the highway. Likewise, Point "c" does not represent average driver performance because the ordinary driver is not interested in arrow design, and will not wait until he can distinguish design detail in finding out which way to go.

For practical purposes, therefore, and for purposes of the study, the intermediate Point "b" was chosen as the point most representative of ordinary driver performance. This necessitates some judgment on the part of the observers, but the fact that the two groups making observations on two different days gave a median value which was consistently similar would indicate that these judgments varied around a certain true judgment point. In order to approximate this central point as nearly as possible, median values have been used in the analysis of the results.

The legibility distances obtained for the four and six inch Series "D" square letters showed good general agreement with those obtained in the previous more extensive alphabet study. The results show that the conditions for the observations were generally similar, and that the relatively small number of observers represent eyesight varying both above and below normal, and thus making valid the use of the median value. Visual tests were also obtained on half of the observers.

Again in this study, as in the previous study, the results seem to indicate that the night condition is very critical in evaluating the efficiency of highway signs. In certain cases it appears that the arrow design which is best suited for day legibility is not as good under night conditions when reflectorized. More cannot be said until the detailed results are reported.

Although it is not yet possible to give the relationship between the legibility distance and the various characteristics of the arrow design, it is apparent that the best designs of painted arrows give a greater legibility distance than do the Series "D" square letters, i.e., more than fifty feet to the inch of height.

From the detailed analysis it will be possible to select certain combinations of head and shaft design for destination sign arrows to give the greatest efficiency in terms of legibility distance for the amount of sign space used. After this is done, the characteristics of both the letter copy and the arrows will be known, and it will be possible to improve the balance between words and arrows on any destination sign so as to gain the greatest over-all efficiency. That is, the design can be improved to gain greater reading distance and to obtain legibility of both the name and the direction arrow at the maximum distance.

A summary of the detailed results and conclusions will appear in a later issue.

TACKLING TRAFFIC IN SOUTHERN CITIES

by CHARLIE BISHOP

WHEN in the late 1880's the reconstruction of Atlanta got under way, little attention was paid to city planning. So, as the city slowly began to develop into the business center of the South, property owners divided their holdings to suit themselves, with apparently no attempt to lay out a logical, city-wide street plan. As a result, streets strike off at every conceivable angle, come together five at a time, and altogether add up to one of the most difficult traffic problems in the country.

Atlanta, like most other large American cities, is developing a ring of decayed property around its very heart which year by year grows stead-

ily wider as citizens with adequate incomes transfer their residence from the inner city to the suburbs.

The biggest obstacle to the construction of badly needed facilities is the problem of right-of-way acquisition. Particularly noticeable in Knoxville, Tenn., Charleston, Greenville and Spartanburg, S. C., where modern divided-lane highways carry the motorist up to the city limits and there deposit him in a maze of narrow city streets, it has completely stymied the efforts of most American cities.

Some, like Atlanta, have relocated new entrances in order to avoid the ribbon developments extending far out from city limits on older routes. However, when the new facility does encounter built-up sections, the right-of-way problem again becomes acute. Pressed for funds, states and municipalities have had to limit right-of-way acquisition to the absolute minimum, with the following results:

The newly constructed facility partially defeats its ends, for without excess right-of-way, roadside developments spring up, making it impossible to limit access.

When it is again necessary to improve the facility, adjacent property will once again have undergone a price rise.

This writer, in talking with city and state highway engineers throughout the South, was told time after time that the problem of right-of-way acquisition was the main, and practically the only, stumbling block in the express-highway construction programs.

Recognizing that this situation is the most difficult facing state, municipal and county authorities, Thomas H. MacDonald, Chief, Public Roads Administration, suggests that the " . . . problem could be greatly simplified and in a large measure eliminated with respect to major highways and streets if there were some central agency with sufficient funds and authority of law to acquire the lands necessary for the improvement of such highways and streets at a period substantially in advance of the time when the improvements actually would be made."

In order to avoid the near-prohibitive costs of metropolitan expressways, it has often been suggested that bypass routes, designed to take through traffic off the city streets, be constructed. However, traffic data gathered by state-wide highway planning surveys conclusively show that only about 10 to 15 per cent of the traffic on main rural highways wishes to avoid metropolitan areas—a percentage so small that draining it off on bypass routes would afford little or no relief.

There is nevertheless a definite need for facilities of this type. Around large cities and many smaller ones, they would more properly be called "belt-line distribution roads." Such roads have some of the characteristics of bypass routes, and may actually serve to bypass a considerable amount of through highway traffic around the city. Their primary purpose, however, is something different. Belt-line distribution roads, circling the city at its outer fringe or in the decadent section surrounding the business district, serve to distribute traffic approaching the city on any highway either to other highways or to points on the circumference of the city nearest that traffic's ultimate destination.

At present, intelligent planning is the primary need. Fortunately, the services of the various state-wide highway planning surveys are available to most cities for this work.

Condensed from an article by Charlie Bishop, Secretary-Manager, Atlanta Motor Club. AMERICAN CITY, July 1940, pp. 42, 43.

DESIGN FEATURES—PENNSYLVANIA TURNPIKE

by CHARLES M. NOBLE

SAFETY in vehicle operation is perhaps the most important factor in presenting highway expansion. It was made the keynote in the design of the Pennsylvania Turnpike. In providing this inherent safety a number of objectives were considered fundamental:

1. Separation of streams of traffic flowing in opposite directions to reduce the possibility of head-on collisions and side-swipe accidents.
2. Elimination of all highway and railway grade crossings, so that there will be no cross traffic.
3. Provision of wide, smooth, stable shoulders level with the pavement to enable vehicles to park completely off the paved area and to provide "elbow room" in cases of traffic emergency or mechanical failure.
4. Provision of two lanes of pavement in each direction in order to reduce the menace due to slow-moving vehicles, to eliminate the necessity of encroaching on the lanes of opposite-direction traffic when passing, and to obviate delay in passing.
5. Construction of traffic lanes of sufficient width to care adequately for the safety, comfort, and convenience of all classes of traffic.
6. Elimination of all frontage, "wildcat" commercial development, and local farm entry along the right of way, and the complete control of that right of way.
7. Exclusion of pedestrians.
8. Provision of moderate grades to increase safety during icy weather and to increase the speed of large heavily loaded trucking units so that rear-end collisions between fast and slow vehicles are minimized.
9. Arrangement for uniform and consistent operating conditions.
10. Provision of specially designed access facilities at reasonably long intervals, with acceleration and deceleration lanes in order that vehicles may enter and leave the main highway with reasonable safety and a minimum of traffic disturbance.

The roadway cross section consists of a 10-ft. medial zone which separates one 24-ft. roadway carrying eastbound traffic from another carrying westbound traffic. Paved lanes are 12 ft. in width, and the pavement is flanked with 10-ft. shoulders on each side. Design objectives 1 to 5 are thus attained. Elimination of all frontage and the complete control of the right of way are provided in the legislative act creating the Turnpike; the presence of pedestrians will be minimized, if not entirely eliminated, by fencing along the right-of-way lines and enforcement by operating personnel. Maximum grades have been limited to 3%, and this is particularly remarkable in view of the fact that the Turnpike traverses the difficult region of the Allegheny Mountains. Such a flat maximum grade has only been possible because the higher ridges have been pierced with seven tunnels, aggregating 6.7 miles in length.

From the beginning a constant effort was made to improve the alinement as much as possible, consistent with the necessary economy in excavation quantities. Throughout the design period an unceasing effort was directed to reducing the degree of horizontal curvature with the result that the 6° 00′ maximum curvature has been confined entirely to one section approximately 6 miles in length. The degree of the remaining curves has been reduced wherever possible, so that, of the 191 curves on the Turnpike, only 8 others are sharper than 4° 00′.

It was recognized that a certain amount of hazard would be presented to the motorist if a sharp curve were introduced in a section with easy curvature on each side. Consequently all the curves on the Turnpike were examined and each group of curves was so arranged that the operating speed on adjacent curves would not, in general, vary more than 5 to 8 miles per hour (wherever the topography made such a procedure possible). This refinement should eliminate the element of surprise and of failure to negotiate horizontal curves.

Rear-end collision sight distance has been based on the vision from the eye of the driver to a stone or other obstruction 4 in. high. In comparison the sight distance to another car is greater than the foregoing limit on horizontal curves flatter than 3° and practically twice as great on vertical curves. The desirable sight distance is assumed to be 1,000 ft. and the minimum distances required are:

For 50 miles per hour	425 ft.
For 60 miles per hour	565 ft.
For 70 miles per hour	720 ft.

In view of the rather general agreement among highway engineers that a rate of 0.10 ft. per ft. of width (1-3/16 in. per ft.) is the maximum that should be used in climates where ice and snow are prevalent, this maximum was adopted. Because curvature sharper than 5° 15′ was confined to one section, as previously noted, it was decided to attain the maximum rate of 1-3/16 in. per ft. on reaching the 5° 00′ curve. After considerable study the conclusion was reached that the intermediate rates of superelevation (that is, from 0 to 0.10) should be established on a basis of providing a reasonably "straightline" speed curve for each assumed friction value.

The speed curves, when plotted on a diagram, assimilate a reasonably straight-line relation, as well as the very consistent operating conditions applicable on an icy surface. For design purposes the speeds used in determining spiral lengths, and daylight and head-lamp sight distances, were taken from a curve corresponding to a friction factor of f=0.10, except that the tendency for "over-driving" curves sharper than 2° 45′ was recognized and provision was made therefor. Curves flatter than 2° 30′ permit a speed greater than 70 miles per hour at 0.10 friction. This illustrates the undesirability, from the standpoint of safety, of providing under these particular conditions more superelevation in curves flatter than 2° 30′ because of the limitations necessarily imposed on safe operation by sight distance.

Unfortunately, there are no official tests on the available amount of friction provided between tires and road surface before skidding occurs at speeds much in excess of 60 miles per hour, but tests made at Iowa State College by R. A. Moyer, indicated that at around 50 miles per hour smooth wet concrete surfaces provide an ultimate coefficient of friction of approximately 0.5, or 5 times greater than that utilized in the design. High speed tends to give the driver the feeling that the car is "light on its feet"; this phenomenon should induce him to keep the speed down on curves.

Because no one to the writer's knowledge has attempted to make observations on the behavior of drivers, and the amount of friction the majority of them are willing to utilize on horizontal curves at high speed, it is not possible to predict what speeds will actually be obtained on the Turnpike. It is interesting to speculate, however, on what these speeds may be. Disregarding the 1% "speed demon" group, and considering the next 10% group of fast drivers, the probable speed is in excess of 70 miles per hour for all curves flatter than 4° 30′,

which further illustrates the fact that the speed possibilities provided by the adopted rates of superelevation are materially greater than could be met by sight distance requirements within available funds.

At practically every one of the nine intermediate entrances it has been possible to arrange the grades so that the interchange is located at the center of a long sag in the grade line and so that at least 600 ft. of pavement will be visible to the motorist before he reaches any deceleration lane. Thus the interchange should be visible far enough in advance to eliminate the element of surprise that would be present if it were located on the top of a rise instead of in a sag. This feature will also permit the motorist to obtain a bird'seye- view of the layout so that he can more readily distinguish the point of exit and plan accordingly. As to details of the turnout, the design was based on the possibility of the motorist entering at a speed of 56 miles per hour, and then allowing him time and space to decelerate to 20 miles per hour as required by the 100-ft. radius "loop." In arriving at the shape of the turnout, the factors were brake reaction time, braking friction amounting to f=0.20, and unbalanced centrifugal friction amounting to f=0.20. The application of these factors resulted in a curve closely similating a spiral; but for simplicity in field layout a series of compound curves were utilized which conformed very closely to the locus of a true spiral. It was felt that such a treatment, allowing for a high initial speed at the point of turnout, was imperative owing to the psychological fact that motorists after having driven over considerable distances at high speed, very generally have the sensation of traveling at a low rate of speed when the pace is slackened relatively little, usually an amount of only 10 to 15 miles.

In closing it is to be emphasized that the fundamentals of safe vehicle operation have been utilized in the design of the Pennsylvania Turnpike and in spite of almost impossible time schedule a tremendous amount of study has been devoted to special features and details of design.

Condensed from an article by Charles M. Noble, Special Highway Engineer, Pennsylvania Turnpike Commission. CIVIL ENGINEERING, July 1940, pp. 437-440.

BUILDING SAFETY INTO STREETS

by JOHN G. MARR

WE all assert that there are too many deaths and personal injuries resulting from traffic accidents. In Oakland between 1932 and 1940—eight years—650 persons were killed and in addition 15,802 persons were injured. Can we say that the public safety and welfare are being maintained when such a waste of human resources is permitted? The financial losses represented by these deaths and injuries is a substantial sum which, in the final analysis, is paid by the general public. It is believed that these economic losses can be reduced, and many of the accidents can be avoided, by the application of engineering methods to selective police enforcement and by emphasizing the need for building safety into the street structures, combined with continuous educational efforts emphasizing the need for public cooperation.

In Oakland, all matters pertaining to traffic are handled by one agency irrespective of the department of the

city to which they are directed, so that they will be considered from the enforcement angle, and from the several engineering phases as represented by the Electrical, Street, Engineering, and City Planning Departments. The heads of all these city departments and certain civic agencies constitute the Traffic Committee of the City of Oakland.

In the fundamental approach to the solution of traffic problems, the Traffic Committee has accepted three definite premises: (1) traffic must move expeditiously; (2) the maximum degree of safety must be assured, consistent with moving the traffic; and (3) private property must be used with a reasonable degree of facility.

One school of thought, in the belief that safety must be the only consideration, has gone so far as to construct dips at intersections to force traffic to slow down or suffer the consequences of its oversight, and has installed stop signs and traffic signals in abundance. Such reasoning has done more to scrap organized safety campaigns than any other single factor.

What is needed is a fresh attack directed toward the traffic loads on the limited street space, and planning the necessary express highways, economically conceived, at the strategic locations.

The experience gained in handling particular problems is being incorporated in the city's program of long-time planning. All readjustment in present pavement widths and design of new streets and thoroughfares is being reviewed by the traffic engineering division.

It appears obvious that there must be a change in the fundamental concept of street planning, as exemplified by the present street pattern, if the cities are to move traffic with safety. The number of intersecting streets must be reduced. The city is contemplating the creation of one express highway, with more to follow. Separator strips will be sufficiently wide to permit cars turning off to be fully protected in the front and rear. The added widths in the separator strips at the intersections can be used at a later date, should grade separations be undertaken.

The Traffic Committee experiment being undertaken in Oakland affords a direct coordination of the city's efforts in handling the immediate problems and in caring for the future. Subdivisions, as they are submitted, are considered from a traffic standpoint as well as from the usability of the land for the purpose for which it is being laid out. The use of abutting land for business purposes can offset a street widening for facilitating traffic movement. The tie between the City Planning Commission and the Traffic Committee again helps to hold to a minimum the amount of property opened up to business use after a new highway is constructed.

This building-in of safety for the present and for the future is a most challenging problem. Much can be done if the engineer will work in cooperation with the enforcing agency and education organizations. Success or failure will be dependent upon our ability to solve the personal equation involved in securing the necessary cooperation.

Condensed from an article by John G. Marr, City Planning Engineer, Oakland, Calif. AMERICAN CITY, July 1940, pp. 59-61.

TRAFFIC AIDS TO TEXAS MUNICIPALITIES

by ROBERT O. SWAIN

THE state of Texas is safety-conscious. An effective state safety association, a progressive group of traffic engineers and enlightened traffic and police organizations, are laying a foundation for a program to reduce motor-vehicle accidents in the Lone Star State.

Most American cities having traffic signals in their downtown area for the last ten years, are seriously handicapped in attempts to get any flexibility from such a signal system. Amarillo is no exception. Overhead suspended signal lights are fed by five conductor cables, making any renovations costly. The recommendations made to the city for improving its signal system included three proposals. The three proposals were made in order to give Amarillo immediate relief and to provide it with some plan for future development of a progressive synchronized downtown signal system. Proposal No. 1 consists of the most modern type signal installation with the following features: (1) flexible progressive traffic control system—that is, a green light at any intersection can be brought on any predetermined time with regard to the timing of a master controller; (2) two spare conductors in the interconnecting cable; (3) one spare conductor in the intersection cable after the walk lights are in service; (4) one spare interval in the timer after the walk lights are inserted; (5) provisions for any sixth interval color cycle for a two-street intersection; (6) individual percentage time adjustment at each intersection; (7) adjustable total time cycle.

Proposal No. 2 is based on using existing signals and cable and consists of installing individual controllers at each intersection, using the existing cables to supervise these controllers and installing service cable to give 110 volts at each intersection. The features of this system include: (1) flexible progressive system as outlined in proposal No. 1 of the preceding paragraph; (2) one spare conductor in the interconnecting cable; (3) provision for any sixth interval color cycle with two extra cables for walk light when necessary and one spare interval; (4) individual percentage adjustment of the time at each intersection; (5) adjustable total time cycle.

Proposal No. 3 is based on modernizing the existing traffic-control equipment so that the large percentage of the total time cycles can be allowed on Amarillo's main street (Polk Street), and yet the signals can be staggered in timing so as to permit the same progressive speed as obtained under the existing system. The main features of this system are: (1) progression with long percentage of time on Polk Street; (2) progressions for walk lights on Polk Street; (3) all intersections not on Polk Street to be operated on a 50-50 time division; (4) all intersections synchronized with each other; (5) one spare cable on Polk Street after walk lights are put in service.

Brook Avenue and Eleventh Street in Wichita Falls, Texas, form an offset intersection. The chief difficulty at this location was the "cutting of corners" by vehicles forming their own transitions in traveling from one side of Eleventh to the other. The traffic at the intersection was heavy enough to justify the installation of a fixed-time signal. This traffic-control device was erected before the Texas Highway Department made a survey of the

city. The cycle on the signal light was split so that Eleventh Street received a green light while Brook had a red light, etc. This type of signal light did not eliminate "corner cutting." Following the Highway Department survey, it was recommended that centerline concrete buttons, approximately 3½ inches high, be placed on Eleventh. This form of channelization will control the turning movements on both Brook and Eleventh and eliminate possible medial friction created by vehicles on Eleventh Street "cutting corners."

Condensed from an article by Robert O. Swain, Assistant Traffic Engineer, Texas Highway Department (Jun. I.T.E.). AMERICAN CITY, July 1940, pp. 85, 87, 89.

CENTER-STRIPES THAT WON'T WEAR OUT

THE Highway Department of Lucas County, Ohio, is using a simple new method to apply permanent center-striping to concrete pavements. Credit for the method used goes to J. D. French, of the Texas State Highway Department. Mr. French has patented the system, and the Texas department is also making use of it in concrete highway construction.

The stripe is formed by a deposit of black oxide of iron, which impregnates the concrete. Chemically precipitated magnetic iron oxide is blown on to the fresh concrete by means of a lime duster, and smoothed out with first a wooden float and then a steel float. To make the line sharp and accurately straight, and to protect the newly placed concrete while striping, the Lucas County Highway Department built a bridge that rides on wheels along the side-forms in much the same manner as the pavement finisher. The bridge is built of steel I-beams, reinforced and stiffened laterally with small angles. In the center are two channels placed 6 in. apart, with angles fastened to the bottom edges of the channels to bring a cutting edge of steel in contact with the pavement. This center assembly can be raised or lowered as necessary by means of a handwheel at each end.

As the striping bridge moves along the new surface in the wake of the paver, the iron-oxide dust is blown down between the guiding channels and angles. The material, worked in with the wooden and steel floats, penetrates to a depth of ⅛ to ¼ in., and when the concrete has set, the centerline is there to stay—for as long as the pavement is there to carry traffic.

According to County Engineer B. G. Kesting, Lucas County laid approximately 62,000 sq. yds. of concrete, most of it 20 ft. in width, last year; all of this was striped by the iron-oxide method. The cost of the striping material comes to slightly more than $11 per mile, 2½ lb. being used for 100 ft. of 6-in. stripe, and the material costing 8½c per lb. In a rough estimate of labor costs, Mr. Kesting states that the services of one full-time man and one part-time man are required, and that about 100 lin. ft. of marking can be placed in an hour—a labor cost of $1.25 per hour ($1 for the full-time man, 25c for the part-time labor required). This brings the cost of striping, less cost of equipment, to approximately $77 per mile.

The striping bridge used was built by county forces from salvaged materials, a $35 set of wheels being the only new parts used in its construction. To build the machine required 45 man-hours of labor.

Condensed from an article appearing in BETTER ROADS, July 1940, pp. 25.

STANDARDIZING MOTOR VEHICLE INSPECTIONS

by HAROLD F. HAMMOND

FOUR elements, singly or in combination, are responsible for all motor vehicle accidents—the driver, the pedestrian, the highway and the vehicle. The vehicle, it is generally agreed, is not the most important contributing factor, but it is important enough not to be ignored. True, the manufacturers are endeavoring to build safety into the car, but the vehicle still contributes, directly or indirectly, an estimated 3% to 10% of the accidents.

In 1929 the Massachusetts legislature passed one of the first statewide motor vehicle inspection laws. Since that time statewide inspection programs have been vastly improved and refined. Seventeen states now require periodic inspection of motor vehicles.

There are still those who question the value of periodic motor vehicle inspections. One argument frequently advanced is that inspections do not show a sufficient return to warrant the added burden upon the motorists, and that the time and money devoted to inspections would yield much greater results if applied to other methods of accident prevention in the traffic field. Again, it is sometimes argued that some states without periodic motor vehicle inspection show as favorable an accident trend as states with inspection. To make such comparisons when the accident rate depends on so many variables is impractical, especially when it is impossible to measure accurately other safety efforts along lines of enforcement and education. The best rebuttal to such an argument is an annual report from one of the existing inspection programs. The results of any statewide inspection are indicative: approximately 50% of the vehicles are found to need brake or light improvements. Isn't this sufficient proof that vehicles may play a greater part in accident causation unless they are periodically inspected, and conversely, that many accidents can be prevented through a system that detects "unhealthy" vehicles?

We should realize, therefore, that periodic motor vehicle inspections are here to stay. Hence necessity arises, to standardize such examinations. Certainly there is one type or one grade of inspection that is better than any other. The best one, therefore, should be established as a standard. Such standardization should cover not only the inspection items but inspection methods and inspection equipment as well. The first step toward developing such standards has already been taken. Last Fall a motor vehicle inspection code was completed and approved as an American Standard. The code set forth minimum and only minimum standards for vehicle performance. These minimum standards are functional only. No attempt is made to designate how the inspection should be conducted.

It is widely recognized that inspection of vehicles, to be effective, must be applied uniformly, so that one motorist may not feel that he is forced to maintain his car up to a high standard of safety while another in a neighboring city or state endangers all by driving a less safe car. Such uniformity and adherence to high standards are especially necessary under the appointed system of inspection stations such as you have in Massachusetts.

A code setting minimum standards for motor vehicle inspection and a Manual describing methods of application constitute the first major step in placing periodic motor vehicle inspection on a higher plane.

Condensed from an address by Harold F. Hammond, Director, Traffic Division, National Conservation Bureau (Sec'y I.T.E.), before the Massachusetts Safety Conference, Boston, Mass., March 11, 1940. Mimeo. 7 pp.

KEEP 'EM ON THE RIGHT SIDE!

by BERNARD C. HARTUNG

NEVADA is doing something about restricted sight areas on its highways. During the past three years the State Highway Department, through its planning division, has made an exhaustive study of sight distances, excessive curves, excessive grades and super elevations.

Applying the results of this study, the department has inaugurated a state-wide program for 1940 which will include striping and marking of "no passing" zones for approximately 1,300 to 1,500 miles of the state highway system.

Nevada drivers are confronted with terrain which includes long, easy tangents, interspersed with rolling hills and accompanying curves. On one of the state's primary routes—U. S. 40—a survey disclosed 28 horizontal right curves, 71 horizontal left curves, 118 vertical curves, 119 momentary curves where restricted sights existed, and 16 combination horizontal and vertical curves of great length.

The method of identifying "No Passing" sections was relatively simple. A specially-schooled field party, consisting of a chief party, instrument man and a recorder, made a survey of the roads. Two cars were used, and the drivers were required to maintain a uniform interval of 1,000 feet between cars.

This uniform interval was maintained by the use of an interceptor on the rear car and a measuring rod on the advance of the machine. In cases where the 1,000-foot space could not be maintained due to an obstruction of view, Car No. 2 would signal Car No. 1 by radio.

The length of the roadway section in question then was measured carefully with a specially designed odometer reading to hundredths of a mile. This section then was definitely designated as a "No Passing" zone, subject to the treatment described hereafter.

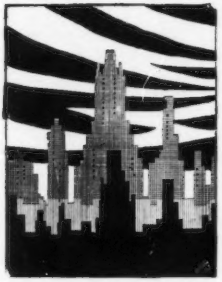
The thousand foot minimum applied only to the non-mountainous areas where a designated speed of 60 m.p.h. was established. In the mountainous regions, this minimum was reduced to 650 feet on a basis of speed of 45 miles an hour.

The accident record of Nevada during the past three year shows that a good percentage of collision and sideswipe mishaps occurred at points where the sight distance was limited. Recommended treatment to relieve such conditions consist of the placing of a solid barrier line in the driver's lane during that interval when his sight distance is restricted.

At the point where maximum vision is again attained, the barrier line ends and passing again is permitted. This same restriction applies to traffic moving in the opposite direction, with the "No Passing" lines overlapping at the point where the view of both operators is limited. An improved type of traffic line machine which paints three stripes simultaneously, thus permitting rapid and efficient marking of restricted sections, was developed. This applicator which is motivated by a two-ton truck (the latter carrying paint tanks and compressor), has a direct-drive control, facilitating the application of a straight line. It is believed that motorists soon will become familiar with this marking and signing without the necessity of installing signs at each "No Passing" zone.

The clear, well-marked center stripe and the accompanying restricted zone treatment, which will be applied during the coming year, will not cover all of Nevada's improved highway system. However, it will take care of a substantial part of it, and is a good indication that state-wide coverage is in the offing.

Condensed from an article by Bernard C. Hartung, Director, Traffic & Safety Division, Nevada Department of Highways (Jun. I.T.E.). PUBLIC SAFETY, May 1940, pp. 16, 17.



Traffic Engineering NEWS

Report of the Nominating Committee

The Nominating Committee respectfully submits its candidates for officers in the Institute of Traffic Engineers for the year 1940-1941. The President and Vice-President were nominated to succeed themselves.

For President	Hawley S. Simpson
For Vice-President	D. Grant Mickle
For Secretary-Treasurer	W. Graham Cole
For Director (John T. Gibala vacancy)	Harold F. Hammond
For Director (W. F. Rosenwald vacancy)	Edward J. O'Meara

Are You on the Suspension List?

Members whose dues expired October 1, 1939, and who have not forwarded remittances in response to dues invoices will be placed on the list for formal suspension by the Board of Direction at its next meeting. If you are one of these delinquents be sure to send in your dues immediately so that you will continue to receive TRAFFIC ENGINEERING.

The Constitution reads as follows:

ARTICLE IV, Section 7. "Any member whose dues are more than six (6) months in arrears shall lose the right to vote. Should his dues become one (1) year in arrears, his connection with INSTITUTE shall be forfeited. The Board of Direction, however, may for a cause deemed by it sufficient, extend the time for payment and for the application of these penalties."

News from the Field

George Houston, Yale Fellow, has been appointed city traffic engineer for Tucson, Arizona.

Miss Margaret Woolverton, only feminine traffic engineer in the country, is now serving as traffic engineer for the Traffic Commission in San Bernardino, California.

G. B. McKendrick, Jr., Yale Fellow, has been appointed traffic engineer of the newly formed Traffic Engineering Division, State Highway Department, Delaware.

George T. Papageorge, Yale Fellow, has been appointed traffic engineer of the newly formed Traffic and Safety Division, State Highway Department, Georgia.

Ross T. Shoaf, Yale Fellow, has been appointed assistant traffic engineer of the city and county of San Francisco, California.

Resolutions Committee Conducts Research on Fundamental Traffic Engineering Problems

Research work of a highly important nature was conducted June 20-23 by the F & F Club, parent organization of the I. T. E., and inspiration for some of its most touching "Resolutions." Balsam Lake, Wisconsin, was selected as the most inaccessible and out-of-the-way place that could be found for the Resolutions Committee meeting. So great was the interest in the serious matter before the Committee, however, that not only Chairman DeYoung and Vice-Chairman Abbott were present, but also members Abbott, Brandes, Ilgner, Munch, and Sorenson.

The items of business disposed of included 3 perch, 6 birch, 50 bass, 2 basswood, 1250 pancakes, 1 finger, and one set of car keys, not to mention a lot of stuff that was temporarily tabled and then voted down.

The Committee feels that it has now collected sufficient data to make the Bisquit Banter Breakfast, to be held in Chicago in October, of vital concern to every traffic man at the Convention, whether a member of the Institute or not.

Marbelite Trailers Hit the Road

The Marbelite Company, Inc., New York, N. Y., has unleashed a squadron of Trailers that are out to "signal" all Traffic Engineering Departments.

The group is headed by Mr. Arthur Myers, Sales Manager of the Company, whose route takes him to the West Coast.

These new Marbelite Trailers carry in their compartments sample Marbelite Signals, and will hit the major cities throughout the country.

Keep an eye out for them if you want to actually see the signals that are causing so much talk throughout Traffic Engineering circles.

Arthur N. Johnson

Word has come of the death of Arthur N. Johnson, Honorary Member of the Institute and Dean Emeritus of the College of Engineering of the University of Maryland.

Dean Johnson was born in 1870 and educated at Harvard and the University of Maryland. The greater part of his professional career was devoted to highway work, being successively assistant engineer of the Massachusetts Highway Commission, State highway engineer of Maryland, chief engineer of the U. S. Office of Public Roads, State highway engineer of Illinois, and consulting highway engineer of the Portland Cement Association. In 1920 he was appointed Dean of the College of Engineering of the University of Maryland, holding that position until 1936 when he was made Dean Emeritus.

Dean Johnson was one of the first highway engineers to become actively interested in the problems of traffic movement, having pioneered in studies of highway traffic capacity. Dean Johnson had been affiliated with the Institute for a number of years and in 1936 was made an Honorary Member.

TENTATIVE PROGRAM FOR ANNUAL CONVENTION

October 5-8, 1940

Stevens Hotel, Chicago, Illinois

The Program Committee, with George W. Barton as Chairman and Robert A. Mitchell as Vice-Chairman, is rapidly pushing the program to completion. Here is the tentative program to date:

SATURDAY, OCTOBER 5

Committee meetings.
Board meeting.

SUNDAY, OCTOBER 6

2:00 P. M. Business meeting.
6:00 P. M. Board meeting.

MONDAY, OCTOBER 7

8:00 A.M. BISQUIT BANTER BREAKFAST

9:45 A.M. TRAFFIC "BULL SESSION" (A Panel Discussion)
Hawley S. Simpson, Chairman

1. Timing Progressive Signal System
2. Fundamentals of Channelization
3. How to Determine Parking Requirements in a Business District
4. Developing a Preferential Street System
5. When and Where Turning Movements Should be Prohibited

2:00 P. M. JOINT SESSION WITH STREET AND HIGHWAY TRAFFIC SECTION, NATIONAL SAFETY COUNCIL
Judge Harry H. Porter of Evanston, Ill., presiding

1. Opening Remarks—Judge Harry H. Porter
2. The Present Challenge of Traffic Accidents—Sidney J. Williams
3. Pedestrian Safety Highlights in 1940—Leslie J. Sorenson
4. The Motorist Looks at the Pedestrian—Burton W. Marsh

TUESDAY, OCTOBER 8

9:15 A.M. "LIVE PROBLEMS FOR TRAFFIC ENGINEERS"

1. Relieving Congestion in Business Districts (Two papers)
2. What's New in Traffic Signs, Signals, and Markings?
3. New Thoughts in Intersection Design
4. Capitalizing on Safety Campaigns

2:00 P. M. "NEW HORIZONS FOR TRAFFIC ENGINEERS"
Wallace L. Braun, Traffic Engineer, Baltimore, Md., presiding

1. Are Traffic Engineers Too Concerned Over Safety?
2. The Traffic Engineers' Contribution to Modern Highway Planning (Two papers)
3. The Automobile Goes to The 'Behavior' Clinic
4. Traffic Engineers' Contribution to the City of the Future

NOTE:
1. The date for the Annual Banquet will be announced later.
2. Reports from the Resolutions Committee will be found on another page.
3. The Convention Arrangements Committee is trying to have all Institute members and friends on the same floors of the hotel. Have *you* made your reservation?

San Antonio Traffic Engineering Section

The recently established Traffic Engineering Section in San Antonio, Texas, has already made considerable progress. Virden A. Rittgers (Associate, I. T. E.), formerly City Traffic Engineer of Oklahoma City and State Traffic Engineer of Oklahoma, is in charge of the department.

The bulk of the work to date consisted in the collection of factual information to guide intelligently, not only in the program of traffic engineering improvements, but also in the City's enforcement and Safety Education programs. Specifically the work included: volume counts; spot maps and high accident locations; engineering plans and specifications; inventory of traffic sign system; traffic ordinances (made preliminary drafts for four new ordinances and checked several proposed ordinances); radio programs; accident records and statistics; cooperation with national safety groups.

Plans have been prepared for several thousand dollars worth of safety improvements, including channelizing and pedestrian islands, streamlining of esplanades, isolation of parking areas on several plazas. At the present time, plans are being prepared for improved signal installations and channelization for three more complicated, multiple street intersections. Approval has also been received for carrying these projects through to completion.

On May 31, a two and a half months volume study of 207 intersections over the city was completed. Summarization of this work is proceeding in the office. From these checks San Antonio's first traffic flow map will be well started.

The City's entire traffic sign system is gradually being brought up to standard by replacement of non-standard signs with standard signs.

Some preliminary work leading up to experimentation with raised lane lines to take the place of plain paint lines has been started. Considerable preliminary work has been done toward the design of a complete new signal system to replace the antiquated down-town system.

The Traffic Engineering Section prepared specifications for four lanes of vehicle testing equipment in connection with the City's proposed compulsory municipally owned and operated vehicle inspection station which is already covered by a new ordinance.

There has been a considerable reduction in the traffic accident toll in the eight months the Traffic Engineering Section has been operating. The results of this work will gradually become more and more evident in improved traffic conditions for the people of San Antonio.

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IS 1939 RESOLUTIONS COMMITTEE SKIT FORGIVEN STOP WOULD LIKE TO RETURN FOR 1940 CONVENTION STOP WANT TO MAKE AMENDS BY PRESENTING A LESS FORMAL PLAY—LESS STIFF SHIRTS, DITTO CAST STOP PRESENT PLANS CALL FOR 20 ELEPHANTS, 69 GIRLS, 600 PIECE ORCHESTRA STOP PLANS SUBJECT TO CHANGE STOP WILL REQUIRE DRAWING ACCOUNT OF AT LEAST ONE MILLION LETTUCE LEAVES STOP DON'T OFFER TEN BUCKS UNLESS YOU REALLY MEAN IT STOP IF 1940 CONVENTIONEERS CAN'T TAKE A JOKE, TELL THEM TO (SIX WORDS CENSORED).

(SIGNED)
SKINNY DeYOUNG
BILL McCONOCHIE

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*A list of the cooperative activities and cooperating members of the Institute will appear in the August issue.

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Chicago, Illinois - October 5-8, 1940

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